# PATENT COOPERATION TREATY

# PCT

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

| Applicant's or agent's file reference | FOR FURTHER ACTION See Form PCT/IPEA/416 | |
|---|---|---|
| 2021726PC/OR | | |
| International application No. | International filing date *(day/month/year)* | Priority date *(day/month/year)* |
| PCT/FI 2004/000174 | 25-03-2004 | 25-03-2003 |
| International Patent Classification (IPC) or national classification and IPC | | |
| G01S 13/93, G05D 1/02, G08G 1/16 | | |
| Applicant | | |
| SANDVIK TAMROCK OY et al | | |

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *(sent to the applicant and to the International Bureau)* a total of 3 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s))
      _____, containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:
   - ☒ Box No. I Basis of the report
   - ☐ Box No. II Priority
   - ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - ☐ Box No. IV Lack of unity of invention
   - ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - ☐ Box No. VI Certain documents cited
   - ☐ Box No. VII Certain defects in the international application
   - ☐ Box No. VIII Certain observations on the international application

| Date of submission of the demand | Date of completion of this report |
|---|---|
| 20-10-2004 | 08-12-2004 |
| Name and mailing address of the IPEA/SE<br>Patent- och registreringsverket<br>Box 5055<br>S-102 42 STOCKHOLM<br>Facsimile No. +46 8 667 72 88 | Authorized officer<br>Göran Magnusson /itw<br>Telephone No. +46 8 782 25 00 |

**INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY**

International application No.
PCT/FI 2004/000174

**Box No. I Basis of the report**

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This report is based on a translation from the original language into the following language _____, which is the language of a translation furnished for the purposes of:

☐ international search (under Rules 12.3 and 23.1(b))
☐ publication of the international application (under Rule 12.4)
☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

☐ the international application as originally filed/furnished

☒ the description:

pages 1-8 as originally filed/furnished
pages* _____ received by this Authority on _____
pages* _____ received by this Authority on _____

☒ the claims:

pages _____ as originally filed/furnished
pages* _____ as amended (together with any statement) under Article 19
pages* 9-11 received by this Authority on 20-10-2004
pages* _____ received by this Authority on _____

☒ the drawings:

pages 1-2 as originally filed/furnished
pages* _____ received by this Authority on _____
pages* _____ received by this Authority on _____

☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, sheets/figs _____
☐ the sequence listing *(specify)*: _____
☐ any table(s) related to the sequence listing *(specify)*: _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, sheets/figs _____
☐ the sequence listing *(specify)*: _____
☐ any table(s) related to the sequence listing *(specify)*: _____

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/FI 2004/000174

**Box No. V** **Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

| | | | |
|---|---|---|---|
| Novelty (N) | Claims | 1-10 | YES |
| | Claims | | NO |
| Inventive step (IS) | Claims | 1-10 | YES |
| | Claims | | NO |
| Industrial applicability (IA) | Claims | 1-10 | YES |
| | Claims | | NO |

2. Citations and explanations (Rule 70.7)

Documents cited in the International Search Report:
D1: US 5999865 A
D2: US 6393362 B1
D3: US 6055042 A
D4: US 5572428 A

D1 discloses a mine vehicle comprising a scanner for guiding the vehicle in forward and reverse and also for detecting obstacles in front of the vehicle. See column 6, lines 19-29.

D2 discloses a mine vehicle comprising a safety zone 44 in front of the vehicle and also in a sideward direction of the vehicle. The shape and size of the safety zone is varied dynamically along the route. The vehicle receives, either directly or through a central station, the positions and safety zones of all other vehicles. A collision warning is issued when the safety zones of two vehicles overlap. See column 2, line 43-column 3, line 26; column 7, line 1-column 8, line 30.

D3 and D4 disclose obstacle detection systems comprising scanning an area in front of a vehicle.

The cited documents represent the general state of the art. The invention defined in claims 1-10 is not disclosed by any of these documents.

The cited prior art does not give any indication that would lead a person skilled in the art to the claimed method and apparatus for collision prevention of a mine vehicle,

.../...

**Supplemental Box**

**In case the space in any of the preceding boxes is not sufficient.**
Continuation of: Box V

especially issuing a warning message if a memory point, the memory points representing the stored locations of obstacles on both sides of the vehicle, resides within a sideward safe area.
Therefore, the claimed invention is not obvious to a person skilled in the art.
Accordingly, the invention defined in claims 1-10 is novel and is considered to involve an inventive step. The invention is industrially applicable.

CLAIMS (amended on October 19, 2004)

1. A method of preventing a mine vehicle from colliding, the mine vehicle (1) comprising at least: a movable carrier (2) that may be driven in a first movement direction (A) and in a second movement direction (B), at least one scanner (13, 14), and a control system including at least a first control unit (4) arranged on the carrier (2); the method comprising:

determining for the mine vehicle (1) at least one safe area (15a, 15b, 15c) provided within an area between minimum distances (16) and maximum distances (17) determined with respect to the vehicle (1);

scanning the environment in front of the vehicle (1) when driving the vehicle (1) in one movement direction (A, B);

carrying out a first collision examination wherein the safe area (15a) in front of the vehicle (1) is monitored, and issuing a collision warning message if an obstacle is detected within the safe area (15a), **characterized** by

determining also at least one sideward (C) safe area (15b) for the vehicle (1),

determining an obstacle-free route (24) on the basis of scanning results, and determining points in a sideward (C) direction of the vehicle (1) to restrict the route (24);

forming memory points (21) on the basis of coordinates of the points restricting the route (24), and storing the memory points (21) in the control system; and

carrying out a second collision examination wherein at least one sideward safe area (15b) of the vehicle is monitored, and issuing a collision warning message if even one of the memory points (21) resides within the safe area (15b) being monitored.

2. A method as claimed in claim 1, **characterized** by

simulating in advance, on the basis of position and control data, the path of movement of at least one part of the vehicle (1) in the control system,

carrying out the second collision examination by taking into account the path of movement obtained by simulation, and

adjusting, on the basis of the second collision examination, steering movements of the vehicle (1) in order to avoid overstepping the sideward safe area (15b).

3. A method as claimed in claim 1 or 2, **characterized** by storing substantially continuously the memory points (21) in a ring buffer provided in the control system, and updating for the second collision examination the memory points (21) in a ring memory with respect to the movement of the vehicle (1).

4. A method as claimed in any one of the preceding claims, **characterized** by controlling the vehicle (1) unmannedly, and utilizing for such control a data transmission connection (6) provided between the first control unit (4) residing on the carrier (2) of the vehicle (1) and a second, external control unit (7).

5. A method as claimed in any one of the preceding claims, **characterized** by updating dimensions of at least one safe area (15a to 15c) on the basis of the location of the mine vehicle (1).

6. A mine vehicle comprising at least: a movable carrier (2) that may be driven in a first movement direction (A) and in a second movement direction (B), at least one scanner (13, 14), and a control system including at least a first control unit (4) arranged on the carrier (2); and wherein

at least one scanner is configured to scan the environment in front of the vehicle (1) in order to detect obstacles (10, 18);

at least one safe area (15a to 15c) defined by minimum distances (16) and maximum distances (17) determined with respect to the vehicle (1) is determined in the control system; and which

control system is configured to monitor scanning results and to issue a collision warning message if an obstacle is detected within the safe area (15a) in front of the vehicle (1), **characterized** in that

in the control system, at least one safe area (15b) in a sideward (C) direction of the vehicle (1) is further determined,

the control system allows several memory points (21) including their position information to be stored therein, the memory points (21) defining sideward (C) points of the route (24) and based on the scanning results, and

the control system is configured to monitor at least one sideward (C) safe area (15b) of the vehicle (1) and to issue a collision warning message if even one of the memory points (21) resides within the safe area (15b) being monitored.

7. A mine vehicle as claimed in claim 6, **characterized** in that the mine vehicle (1) comprises a first laser scanner (13) directed in a first

movement direction (A) and a second laser scanner (14) directed in a second movement direction (B), and that each movement direction (A, B) is provided with a safe area (15a, 15b) of its own.

8. A mine vehicle as claimed in claim 6 or 7, **characterized** in that the minimum distances (16) of the safe area (15a, 15b, 15c) are determined according to the external shape and structure of the mine vehicle (1).

9. A mine vehicle as claimed in any one of claims 6 to 8, **characterized** in that the mine vehicle (1) is unmanned, and that the first control unit (4) is through a data transmission connection (6) connected to a second, external control unit (7) in order to transfer control data between the control units (4, 7).

10. A mine vehicle as claimed in any one of claims 6 to 9, **characterized** in that the control system is configured to update at least one safe area (15a to 15c) on the basis of the location of the mine vehicle (1).